In an alternate embodiment, grooves are formed on the inner surface of the cap top. When the bottle cap is threaded onto the bottle neck, the grooves extend from a location on the inner surface of the cap top within the mouth of the bottle neck to a location extending to the outer edge of the mouth rim or beyond the mouth rim of the bottle neck.

With every embodiment, when the cap is threaded onto the bottle, gases generated within the bottle can escape across the rim of the mouth of the bottle neck through the slots or through the grooves and through the threaded region between the inner surface of the cap rim and the outer surface of the bottle neck to the exterior of the bottle.

In an alternate embodiment, the ridges or grooves are formed on a disc which is fitted in the cap over the cap top inner surface. The disc may be glued on the cap inner surface.

A liner may also be used with the caps of the present invention. This liner is typically fitted over the inner surface of the cap top. An opening is formed in the liner to allow for gases generated in the bottle to penetrate the opening and escape through the slots or grooves formed on the cap top or disc.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partial cross-sectional view of a typical cap threaded onto a bottle neck.

FIG. **2** is a partial cross-sectional bottom view of a cap of the present invention depicting a ridge formed on the inner surface of the cap top having slots formed therethrough.

FIG. 3A is a partial cross-section of a cap of the present invention threaded on to a bottle neck.

FIG. 3B is a perspective view depicting the flow of gases through the threaded space formed between the bottle neck outer surface and the cap inner surface.

FIG. **4** is a partial cross-sectional bottom view of a cap of the present invention having multiple slotted concentric ridges formed on the inner surface of the cap top.

FIG. **5** is a partial cross-sectional bottom view of a cap of the present invention having multiple concentric ridges formed on the inner surface of the cap top having staggered slots formed therethrough.

FIG. **6** is a partial cross-sectional bottom view of a cap of the present invention having grooves formed on the inner surface of the cap top.

FIG. **7** is a perspective view of a liner for used with any of the caps of the present invention.

FIG. **8** is a side view of a cap having a flip top.

FIG. **9** is a side view of a cap having a moveable spout.

FIG. **10** is a cross-sectional view of cap fitted with a disc according one embodiment of the present invention.

FIG. **11** is a cross-sectional view of cap fitted with a disc according to an alternate embodiment of the present invention.

FIG. **12** is a top view of the cap with disc of the embodiment show in FIG. **11**.

FIG. **13** is a partial cross sectional view of a cap threaded onto a bottle neck and incorporating a disk having a ridge and a slot there through.

FIG. **14** is a partial cross sectional view of a cap threaded on a bottle neck and sandwiching there between a disk having a plurality of grooves which extend beyond the rim of the bottle neck.

DETAILED DESCRIPTION OF THE INVENTION

A cap typically consists of a disc shaped top portion **24** from which extends an annular wall or rim **26** (FIG. **2**). Threads **28** are formed on the inner surface **30** of the annular wall **26** for threading on threads **32** formed on the outer surface **34** of a bottle neck **36** (FIG. **3**). The end of the bottle neck has a mouth **40** defined by a rim **42**.

In a first embodiment, the cap of the present invention includes a circular ridge **44** formed on the inner surface **46** of the cap top portion (FIG. **2**). The circular ridge diameter is smaller than the outer diameter of bottle rim, but greater than the inner diameter of the bottle rim defining the mouth. In this regard, when the cap is threaded onto the bottle neck, the ridge **44** sits on the bottle neck rim **42** (FIG. 3A).

One or more slots **48** are formed radially across the ridge. If more than one slot is formed, preferably the slots are equidistantly spaced along the ridge circumference. Preferably, four slots are formed spaced at 90° intervals around the ridge.

When the cap is threaded onto the bottle, the ridge sits on the rim **42** of the bottle neck. A seal **50** is formed between the ridge and the bottle mouth. The slots, however, provide a path for gas to escape from the bottle through the slots and out through the threaded spiraling space **52** between the inner surface of the cap annular wall and the outer surface of the bottle neck as shown by arrows **54** (FIG. 3A) or arrows **55** (FIG. 3B).

In an alternate embodiment, instead of a single ridge, multiple concentric spaced apart ridges **56** are formed (FIG. **4**). Again, preferably each ridge should have a diameter that is smaller than the outer diameter of mouth of the bottle to be capped but greater than the inner diameter of the mouth of the bottle to be capped so that they can all mate with the bottle mouth rim **42** when the cap is threaded on to the bottle. At least a single slot **58** is formed radially across each of the ridges. If more than one slot is formed, preferably the slots would be equidistantly spaced around the concentric ridges. The concentric ridges provide multiple ridge surfaces for sealing with the bottle mouth rim, whereas each slot provides a path for venting to the outside.

In another embodiment, multiple concentric spaced apart ridges **60**, **62**, **64** are formed on the inner surface **46** of the cap top portion (FIG. **5**). These ridges form grooves **68** between them. Again, these circular ridges have diameters such that they will sit on the rim **42** defining the mouth of the bottle neck when the cap is torqued onto the bottle. Staggered radial slots **70**, **72**, **74** are formed across the ridges. Preferably each slot is formed across a single ridge. At least one slot **70**, but preferably two, are formed on the innermost ridge **60**. When more than one slot is formed on a ridge, the slots should preferably be equidistantly spaced around the ridge. Similarly, one, or preferably two, slots **72** are formed on the ridge **62** immediately adjacent the innermost ridge **60**. The slot or slots **72** should not be aligned with the slots **70** formed on the innermost ridge. If two slots **72** are formed, preferably, they are each located at a 180° from each other and spaced 90° away from slots **70** formed on the innermost ridge **60**. One, or preferably two slots **74** are then formed on the next adjacent ridge **64**. Preferably, these slots are aligned with the slots **70** formed on the inner most ridge **60**. This pattern is preferably repeated until slots are formed on all the ridges formed on the cap top portion inner surface. Alternatively, the location of the slots on each ridge may be arbitrary or may be in any other preselected pattern. Moreover, each slot may span more than one ridge and/or the number of slots penetrating each ridge may be different from ridge to ridge.

When the cap is torqued onto the bottle neck, the ridges are seated on the rim **42** of the bottle neck forming a seal. The slots provide a path for gas to escape. Gas will first escape through the slots **70** formed on the innermost ridge **60**

and travel in the groove **68** formed between the innermost ridge **60** and its adjacent ridge **62** until it reaches the slots **72** formed on the adjacent ridge **62** and then escapes through those slots. The gas then follows the various slot and groove paths until it exits through the threaded space **52** between the cap annular wall inner surface and the bottle neck outer surface.

In a further embodiment, grooves **76** may be formed on the inner surface **78** of the cap top portion inner surface **46** (FIG. **6**). These grooves should preferably span to the edge **80** of the inner surface, i.e., the location where the inner surface of the cap top portion intersects the annular wall **82** of the cap, or span to at least a location at/or beyond the outer edge of the bottle neck rim **42** when the cap is torqued onto the bottle neck. Preferably, multiple chord-wise grooves are formed across the inner surface **46** of the cap top portion. The grooves may be parallel to each other and may also cris-cross each other. In the embodiment shown in FIG. **6**, the grooves cris-cross each other forming squares. When the cap is torqued onto the bottle neck, the inner surface **46** of the cap top will seat against the rim **42** of the bottle neck. The inner surface **46** of the cap top portion will form a seal with the rim **42** of the bottle neck. The grooves **76**, however, will provide a path for gasses formed in the bottle to escape across the rim of the bottle neck and through the threaded space **52** between the cap annular wall inner surface and the bottle neck.

The caps of the above described embodiments while allowing gas to vent would also allow some of the liquid to vent if the bottle were turned upside down and squeezed. When squeezed, the liquid material will travel through the slots formed on the ridges and in the later embodiment through the grooves **68**. The liquid material would eventually gel in the slots and/or grooves sealing the slots and grooves. Thus, once the gas generated in the bottle has vented, the slots and/or grooves can be sealed by squeezing some of the liquid material through the slots or grooves as described above, thereby, preventing the escape of any further liquid from the capped bottle.

With all of these embodiments, the grooves, ridges and slots may be machined into the cap which is typically made of a hard plastic material. Alternatively, the grooves, ridges and slots may also be formed by a molding process. The cap with grooves, or ridges and slots may be formed by a single molding process. Alternative the grooves, or ridges and slots may be formed by a combination of molding and machining processes.

Because the grooves or ridges are made from the same hard plastic material as the cap, they are not susceptible to collapsing when under compression, as for example, when compressed against the rim **42** of the bottle mouth under normal cap torquing conditions.

With any of the aforementioned caps, a liner **84** may be used if necessary (FIG. **7**). Typically, the liner will sit against the ridges or the grooved inner surface of the cap top portion. To allow for venting through the liner, at least a hole **80** should be formed through the liner thickness **88**. The hole should preferably have a diameter between about 0.010 to 0.015 inch. The liner thickness should preferably be between about 0.015 and 0.020 inch.

Moreover, any of the aforementioned embodiments may be incorporated in non-conventional caps, such as caps having a flip top or a moveable spout. With flip caps **100**, the top **120** of the cap is hingedly connected to the annular wall or rim **126** of the cap (FIG. **8**). In this regard, the top can be flipped open to allow for the pouring out of the contents of the bottle. With spout caps **200**, a spout **90** is incorporated on the cap top portion **220** of the cap **200** (FIG. **9**). The spout can be rotated from a closed position **90** to an open position **92**. When in an open position, a path is provided allowing for the pouring out of the contents of the bottle. With either type of cap, the ridges or grooves are also formed on the inner surface of the cap top portion as described herein.

Furthermore, the ridges or grooves may be formed, preferably by a molding or a machining process, on a disc **300** made from a hard or semi-hard material such as plastic (FIGS. **10**,**11**,**12**,**13** and **14**). The disc is sized such that it can fit and sit against the inner surface **46** of the cap top portion **24** and such that the ridges **344** (FIGS. **11**,**12** and **14**) or grooves **376** (FIG. **14**) can mate with the bottle neck rim **42** which defines the bottle mouth **40** as described above. In this regard the disc may be used with conventional caps to provide the necessary venting so as to prevent bottle paneling. Moreover, since the disc is made from a hard or semi-hard material, the risk of collapsing of the ridges of grooves which may prevent the venting of gases is decreased. The thickness of the disc should preferably be in the order of 0.030 inch. The disc may be glued to the inner surface of the cap top portion using an adhesive compatible with the contents of the bottle.

The ridges **44** or grooves **376** are formed on one surface **302** of the disc, with the opposite surface **304** being flat (FIGS. **10**,**11**,**12** and **14**). In one embodiment, the disc can be mated to the cap with its flat surface **304** against the cap top portion **24** inner surface **46** (FIGS. **10** and **13**). In another embodiment, the disc is mated to the cap with its ridged or grooved surface **302** against the inner surface **46** of the cap top portion (FIG. **11**). With this embodiment, the flat surface side of the disc mates with the bottle mouth when the cap is torqued onto the bottle. Moreover, with this embodiment, the diameter of the disc should be smaller then the inner diameter of the cap annular wall **26** such that a gap **306** is defined between the annular wall **26** and the disc edge **308**. An opening **310** is formed through the thickness of the disc to allow the gases generated in the bottle to travel from the bottle through the opening and to the grooved or ridged surface **302** of the disc. From there the gas travels in the grooves or through the slots in the ridges and through the gap and through to the threaded space **52** (FIG. **3**) between the cap annular wall inner surface and the bottle neck outer surface.

With this latter embodiment, i.e., the embodiment where the ridged surface is mated to the inner surface of the cap top portion, the ridges act as a spacer to separate the disc from the inner surface of the cap top portion. Moreover, with this embodiment, to prevent the bending of the disc when the cap is threaded onto the bottle, the disc should be positioned such that a ridge is located over the bottle neck rim **42**.